REGIONAL ANESTHESIA

by

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INTRODUCTION

Regional anesthesia is the result of a certain number of delicate procedures by which it is possible to control pain temporarily by interrupting the sensory nerve conductivity of any region of the body. Regional anesthesia is best produced by injecting an anesthetic solution in the immediate vicinity of the nerves supplying the operative field. It is commonly called local anesthesia but it differs from local anesthesia in that the anesthetic fluid is never injected along the line of incision or within the structures of the surgical wound.

Blocking the nerve trunks within the spine but outside the dura mater is called "epidural," "extradural," or "caudal block."

The practice of regional anesthesia is an art as it requires special knowledge of anatomy and skill in its application.

An effort has been made to determine the most efficient anesthetic, the least toxic, the most reliable, and the proper dosage. The animals used have been the horse, hog, dog, and cat.

HISTORY

According to Flagg the history of anesthesia may be broadly divided into two periods, the pre-anesthetic period and the anesthetic period. The pre-anesthetic period ended and the anesthetic period began with the discovery of ether in 1842 and its general introduction in 1846. Local anesthesia though studied several years during the middle of the 19th century by such men as Schurzir, Godep, Bennett, Koller, and others was not well established until Von Aurep in 1879 made rather a thorough investigation of cocaine, using a weak solution under the skin of his arm.

The discovery of the hypodermic syringe by F. Rynd Edinburgh in 1845 made possible a more extensive study and application.

The second most important step, therefore, came in 1884 with introduction of cocaine by Carl Killer although the alkaloid had been first isolated by Gardska in 1855. Shortly after the introduction of this drug, operations such as amputations, trachelectomies, and herniotomies were successfully performed without pain to the patient. The toxicity of cocaine was nevertheless a draw-back and

accounted for many unhappy results. It may be said, therefore, that in the history of local anesthesia there is a third milestone representing the introduction of procaine by Einhorn in 1905.

This drug which is used most extensively today is much less toxic than cocaine and besides possesses other qualities which make it almost ideal in this work.

The toxic action of procaine is less than from any hitherto known anesthetic substance (Braun).

ANESTHESIA

Nerve block is the physiologic section of a nerve at any level, produced by an anesthetic fluid and resulting in the anesthesia of the territory supplied by the nerve. (Labat)

When chemically active substances are brought into contact with sensory nerves they invariably bring about a transient or lasting paralysis, namely, anesthesia. Local anesthetic substances are all protoplasmic poisons paralyzing not only the nerve elements but the function of all protoplasm with which they come in active contact. Their

intense selective affinity for nerve substance is particularly characteristic. They paralyze the function of nerve tissue with which they come in active contact in solutions too weak to appreciably influence other kinds of protoplasm. These substances when introduced rapidly and in sufficient quantity into the circulation besides their local effect produce general symptoms of poisoning. The affinity of these substances for nervous tissue make them particularly toxic to the central nervous system (Braun).

ANESTHETIC AGENTS

Of the anesthetic agents, the salts of cocaine, tropacocaine, eucaine, holocaine, aneson, akoin, stovaine, alypin, apothesine, dulcine, butyn, Waite's local anesthetic, locadyne are the ones most commonly used. In the work here, dulcine, butyn, locadyne, and procaine were used.

Procaine, also named novocaine is preferred to any other local anesthetic agent hitherto known.

1. It is six to ten times less toxic than cocaine hydrochloride.

2. It is not irritating to the tissues and is rapidly and completely absorbed locally.

3. The addition of a solution, adrenalin chloride 1-1000, to its solution hastens and intensifies the action of the drug and lengthens the duration of anesthesia. It is thus the most powerful anesthetic known.

4. It is reliable and constant in action.

INSTRUMENTARIUM

The implements for inducing regional anesthesia are composed of syringes with needles of different dimensions. The thinner the needles the less the trauma to the tissues and the temporary or permanent damage to the blood vessels or nerves, but the gauge of the needle should be compatible with its length and such as would delicately transmit to the fingers an impression of the nature of the tissues approached in the deep regions of the body. Regional needles should be flexible but should not bend, they should be able to pass through all soft tissues with almost equal ease. For small animals a 20-gauge needle 2 inches long is preferred, for hogs an 18-gauge needle 3 inches long is usually ample, while for horses a 16-gauge needle 2 inches long is sufficient. A glass syringe should always be

preferred to a metal one, as they are much more sensitive to the amount of pressure exerted, which is a very important criterion as to whether or not the needles are properly inserted.

REGIONAL ANESTHESIA IN THE HORSE

An intimate knowledge of anatomy is essential and, therefore, I wish to mention a few of the important anatomical features of the region involved.

The equine sacrum consists of five fused segments. The spines are directed backward and rapidly decrease in length posteriorly. The contour of the group, then, is no criterion as to the direction of the sacral canal. The summits of the spines, except that of the first, are often bifid and not very distinct on palpation; the lack of distinctness being due, for the most part, to the extensive attachment of the dorsal sacro-iliac ligament. The space between spines is small and occasionally completely closed by osseous tissue.

The first coccygeal vertebra is always closely and firmly attached and is sometimes ankylosed to the apex of the sacrum. The second coccygeal vertebrae is much smaller

than the first and the spines of the two are separated by a considerable interval. Thus, the first intercoccygeal space is the first one back of the lumbo-sacral junction where a needle may readily be inserted into the vertebral canal.

The sacral canal rapidly diminishes in size from before backward. At the lumbo-sacral junction a noticeable enlargement of the canal exists. This accommodates the lumbar enlargement of the cord, allows for some movement without endangering nerve structures, and provides a large epidural space.

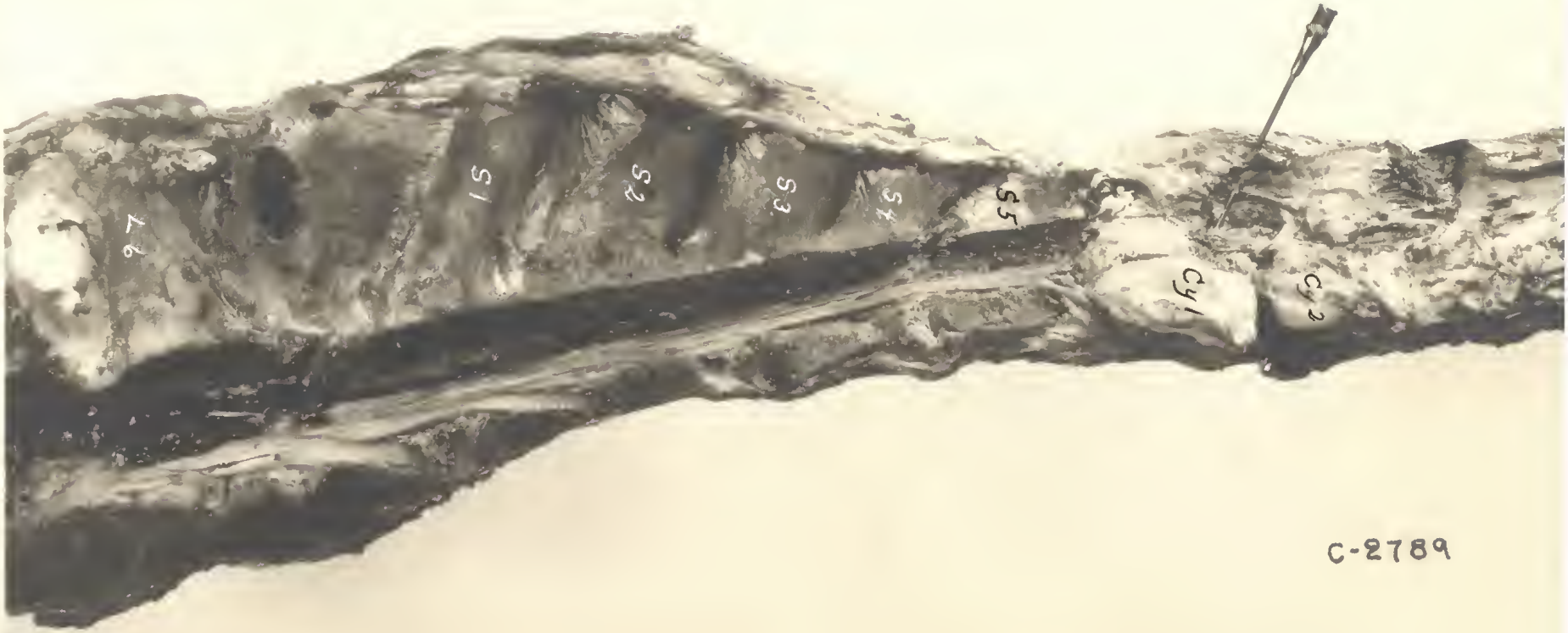
The terminal part of the spinal cord (conis medullaris) ends at the anterior part of the sacrum. In the embryo the arbitrary divisions of the cord (cervical, thoracic, lumbar, and sacral) correspond to similar regions of the vertebral column. Through unequal growth this correspondence becomes unequal in the anterior regions and is lost in the lumbar and sacral regions. The fifth and sixth lumbar spinal nerves are directed backwards, the sixth the length of the last lumbar vertebra, to reach their intervertebral foramina. The sacral and coccygeal nerves traverse the sacral canal. Except at the lumbo-sacral junction and again in the anterior coccygeal region the

the nerve trunks, surrounded by fat, fill this part of the vertebral canal.

The spinal nerves, from the third lumbar posteriorly, supply all the structures back of a transverse plane touching the lower part of the last rib. The pelvic viscera and genitalia, other than those reached by branches of the spinal nerves, are dependent upon the sympathetic system. The latter is connected to each spinal nerve by the ramus communicans. If we can block the spinal nerves as they emerge from the dura mater, we can produce anesthesia in the region supplied by these nerves. (Fig. 1)

In order to learn just where the anesthetic went when injected into the vertebral canal at the first intercoccygeal space, we injected a specimen with a warm, colored agar solution. The specimen was kept in as nearly the natural position as possible during the injection and while the agar hardened. The canal was opened and the agar found in the coccygeal part of the canal and in the epidural space from the first sacral to the third lumbar vertebrae, practically the entire amount being in the latter location. It appears, then, that a small quantity of anesthetic will anesthetize the tail and that a larger amount will "block"

Figure 1. Lateral view of a portion of the vertebral column with the canal opened. The black material below (L-6) is colored agar which was injected into the canal to show distribution of the anesthetic solution. The needle is inserted in the first intercoccygeal space. (L-6) sixth lumbar vertebrae; (S-1, S-2, S-3, S-4, S-5) the sacral spines; (Cy-1, Cy-2) first and second coccygeal vertebrae.



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the nerves at their emergence from the dura mater. In our experimental injections, we were able to anesthetize the tail with as little as 10 cubic centimeters of solution while larger quantities (40 cc) blocked the nerves as far forward as the fourth lumbar. (Fig. 2)

The strength of the solution seems to have an important relation to the degree of anesthesia. In our first successful attempt, we used 60 cubic centimeters of a 2 per cent solution of dulcine. The anesthesia developed rapidly and was complete for the region involved. The mare's hind quarters were so completely anesthetized that she was unable to get up for three hours. Since, we have used 1 per cent solutions, which, so far, have produced the desired loss of sensation and motor incoordination that renders the hind quarters wobbly but allows the animal to stand. Dosages used are 10 to 15 cubic centimeters to anesthetize the tail and from 30 to 40 cubic centimeters for the pelvic viscera and genitalia.

The anesthesia develops rapidly. In five minutes the base of the tail has lost its power of movement. The lower part of the tail is moved from side to side, the upper part is stationary. A noticeable kink, which moves toward the

Figure 2. Lateral view of a portion of the vertebr
column showing the terminal part of the dura mater and ca
equina. (L-5, L-6) the last lumbar vertebra; (S-1, S-2,
S-3) the first three sacral spines; (A) the terminal part
of the dura mater; (B) The canda equina; (F) the first
three ventral sacral foramina.


S3
S2
S1
A
LV6
LV5
LV4
L6
L5

end of the tail, indicates the progressive loss of motility. In ten to fifteen minutes, the gait becomes unsteady, the tail stationary, and the external genitalia relaxed and insensible. In twenty minutes anesthesia is complete. The duration of anesthesia is from one to two hours. When solutions stronger than 1 per cent are used, the sensation and motor reflex are slower in returning.

We locate the site of injection in the horse by passing the finger down the contour of the croup until we come to the first evident depression between the spines. Counting the spines from the first sacral backwards enables one to recognize the first intercoccygeal space with certainty. The animal usually offers less resistance to the operation if a few cubic centimeters of anesthetic, enough to produce a distinct wheal, are injected subcutaneously. The needle is inserted near the center of the depression and given a slant of about 45 degrees to the plane of support. It is essential that the needle be started and kept in the median plane of the body. Occasionally it is necessary to change the slant of the needle, due to striking the edge of the vertebra before entering the canal. Approximately two-thirds of the length is inserted. On injecting the

fluid very little force, other than that necessary to operate the syringe, is needed. One receives the sensation that the injection is being made into another fluid or into space. (Fig. 3)

Figure 3. Position and direction of the needle for epidural injection.

Experimental and Case Reports

Experiment No.1. Aged bay mare of about 1,200 pounds weight received 60 cubic centimeters of a 2 per cent solution of dulcine injected into the sacral canal. The mare was headed down a steep incline. The opinion of several surgeons was that the slope of the sacral canal made this type of anesthesia impossible in the horse. In five minutes the animal began to lose control of the hind legs and almost immediately went down. The loss of sensation and motor reflex was complete and extended as far forward as the ilio-lumbar nerve. In about two and one-half hours sensation began to return and in three hours with some assistance the mare got on her feet and walked to her stall.

Experiment No.2. Aged gray mare of about 900 pounds weight received 30 cubic centimeters of a 1 per cent solution of dulcine injected into the sacral canal. In 20 minutes ovariectomy was performed with no restraint except the stocks. The mare remained standing without difficulty but moved with an unsteady gait.

Experiment No.3. Ten-year old stallion of about 800 pounds weight received 15 cubic centimeters of a 2 per cent solution of dulcine injected at the first inter-coccygeal space. In four minutes the base of the tail was motionless and in ten minutes the entire tail was anesthetized. The anesthesia involved a small area around the base of the tail and the perineum as well as the tail itself. (Figs. 4 and 5)

Figure 4. The first noticeable indication of epidural anesthesia. Note the lack of motion at the base of the tail.

Figure 5. A further stage of epidural anesthesia. The tail is motionless although the flies were numerous. The mare is having some difficulty in standing.

Case Report No. 1. Subject — bay mare, weight about 1,000 pounds, three years old, foaled about three hours before and developed a complete prolapsus of the uterus. An attempt was made to replace the uterus but straining was so violent that it was impossible to do so. Thirty cubic centimeters of a 1 per cent solution of procaine was injected into the intercoccygeal space and all straining stopped in ten minutes.

Case Report No. 2. Subject — black horse, weight about 1,800 pounds, age three years. Monorchid. Horse received 40 cubic centimeters of a 2 per cent solution of procaine into the intercoccygeal space. Operation was performed without apparent pain.

Case Report No. 3. Subject — gray mare, weight about 1,700 pounds. Dystokia. Mare received 40 cubic centimeters of a 1 per cent solution of procaine. In about ten minutes all straining ceased and dystokia was relieved without further difficulty.

REGIONAL ANESTHESIA IN THE HOG

By the use of regional anesthesia, most of the operations performed on hogs may be done under the influence of a local anesthetic. It consists in blocking the nerves supplying the operative area by injecting the anesthetic solution into the epidural space. The area at the site of injection should be shaved and disinfected.

Procaine dissolved in a physiological salt solution to the extent of 2 per cent is used for epidural anesthesia. One cubic centimeter of the 2 per cent solution of procaine for each 10 pounds of pig is usually sufficient to produce the required degree of anesthesia. Surgical anesthesia starts ordinarily in from five to ten minutes after the injection and lasts approximately 30 to 45 minutes.

Technic for Regional Anesthesia

Regional anesthesia in the hog consists in passing the needle through the interspace between the last lumbar vertebrae and the sacrum and injecting the anesthetic solution outside the dura mater. In mature hogs this space is almost

closed so that it is very difficult to use this form of anesthesia in old animals.

The point to insert the needle is located by first drawing an imaginary line across from the anterior borders of the wings of the ilium. Then at a point approximately two and one-half inches posterior to this line and exactly in the median plane insert the needle in a downward and forward direction. The needle will have to be inserted different distances depending upon the condition of the animal. For a 40-pound pig in good condition, the distance will be approximately one and one-half inches and it may be necessary to insert it four inches in a larger animal in good condition. The animal will usually show evidence of pain when the needle enters the spinal canal. It is very easy to insert the needle in the proper place if it is started in the median plane. The solution should be injected slowly and requires no pressure if the needle is in proper position. (Fig. 6)

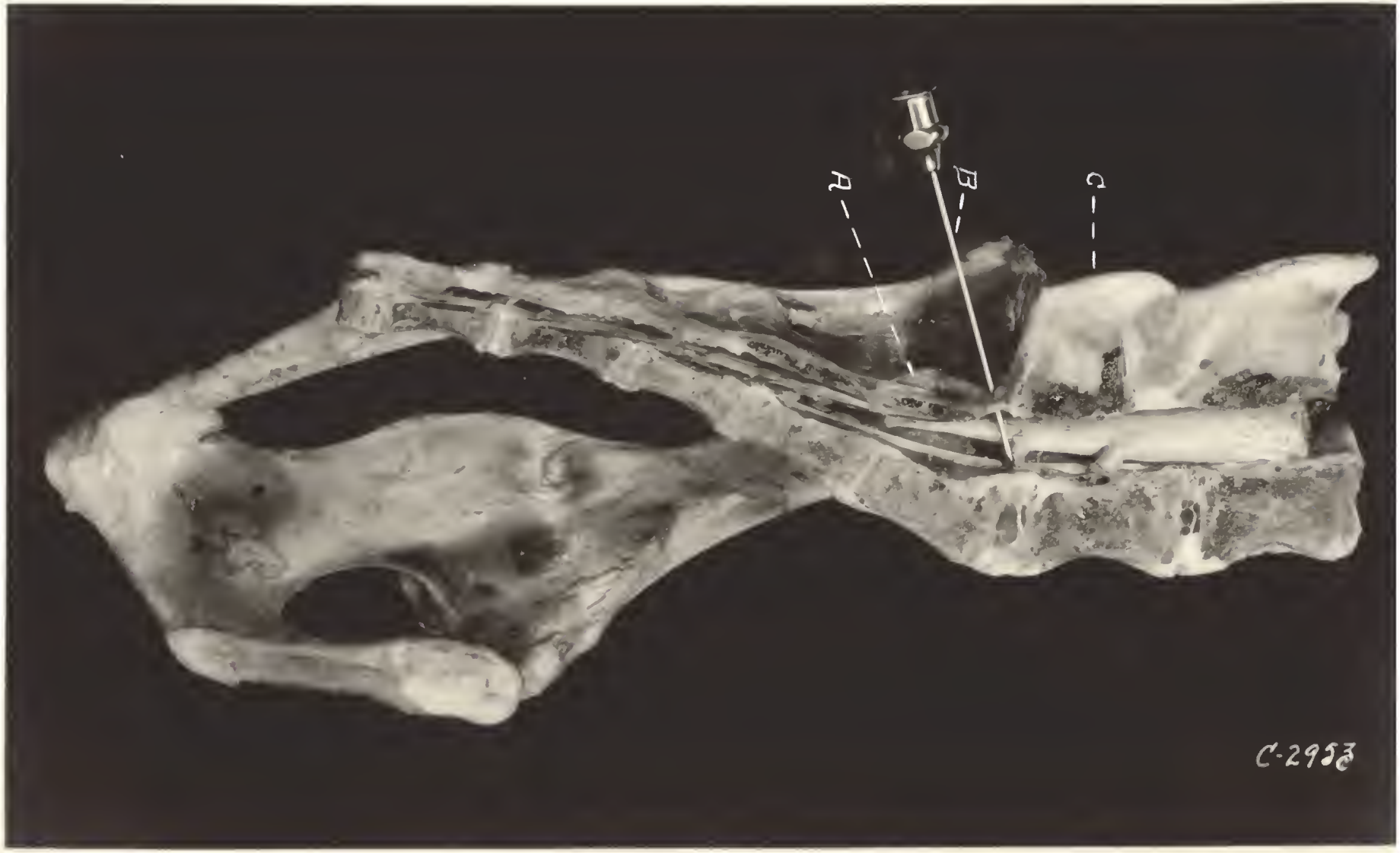

Figure 6. Anatomical structures involved in pig. (A) Sacrum, (B) Needle, (C) Last lumbar verte

If anesthesia is desired for the abdominal cavity, the posterior parts should be slightly elevated for a few minutes so that the anesthetic fluid will gravitate forward and anesthetize the sensory nerves supplying that region. When anesthesia is complete there will be paralysis of the posterior extremities and relaxation of the muscles.

Regional anesthesia may be used during surgical operations for the relief of scirrhous cord, scrotal hernia, monorchidism, and umbilical hernia, and in young gilts for caesarean section. (Fig. 7)

Figure 7. Needle in position to inject the solution.

Case Report No. 1. Male pig weighing about 40 pounds. One testicle retained in the abdominal cavity. Five cubic centimeters of a 2 per cent solution of procaine injected into the epidural space. Anesthesia complete in 10 minutes and the operation performed without pain.

Case Report No. 2. Male pig weighing about 100 pounds. Affected with scrotal hernia. Received 10 cubic centimeters of the 2 per cent solution of procaine into the epidural space. Anesthesia was complete in 10 minutes. The hernia was reduced and the animal castrated without evidence of pain.

Case Report No. 3. Male pig weighing about 50 pounds. Affected with scrotal hernia and umbilical hernia. Animal received six cubic centimeters of a 2 per cent solution of procaine into the epidural space. Anesthesia was complete in 10 minutes. The umbilical and scrotal hernia were reduced and the animal castrated painlessly.

Case Report No. 4. Female hog weighing about 200 pounds. She had been in labor for some time but unsuccessfully. The animal received 15 cubic centimeters of a 2 per cent solution of procaine into the epidural space. Anesthesia complete in 10 minutes. The caesarean operation

was performed without pain.

Case Report No. 5. Five male pigs weighing about 100 pounds apiece. They were all affected with scirrhous cords. Each pig received 10 cubic centimeters of a 2 per cent solution of procaine into the epidural space. Anesthesia was complete in 10 minutes and the operations were performed without evidence of pain.

Case Report No. 6. Female pig weighing about 70 pounds. Affected with large inguinal hernia. Animal received 10 cubic centimeters of a 2 per cent solution of procaine into the epidural space. Anesthesia was complete in 10 minutes and the hernia reduced painlessly.

REGIONAL ANESTHESIA IN THE DOG AND CAT

Regional anesthesia in the dog and cat is of greatest advantage to the practitioner who does not have a trained assistant to administer a general anesthetic.

Procaine dissolved in a physiological salt solution to the extent of 2 per cent is used for regional anesthesia. Analgesia begins almost immediately after the injection and lasts from two to three hours; surgical anesthesia starts

ordinarily from ten to fifteen minutes after the injection and lasts from forty-five minutes to an hour and a half.

Technic for Regional Anesthesia

Epidural block in the dog consists in passing the needle through the interval between the last lumbar vertebrae and the sacrum and depositing the anesthetic within the sacral canal and outside the dura mater. The spinal cord terminates about one-half inch anterior to this space so there is no danger of injuring the cord.

The point to insert the needle may be located by palpating for the depression just anterior to the first sacral vertebrae, or the depression may be located on a line drawn transversely across from the posterior borders of the wings of the ilium.

It is preferred that the animal remain in the standing position so that the anatomical structures will be in normal relation to each other.

An insensitive wheal in the skin at the point of injection is made by injecting a small amount of anesthetic solution within the dermis. The needle should be inserted

exactly in the center of the depression and tilted slightly backward. The needle will have to be inserted from one-half inch in small dogs to two inches in the larger dogs. The operator can usually determine when the point of the needle has entered the canal as the animal will wince with pain, or after some experience the operator will get the "feel." It is very easy to miss the canal if the needle is not inserted exactly in the center of the depression. (Fig. 8)

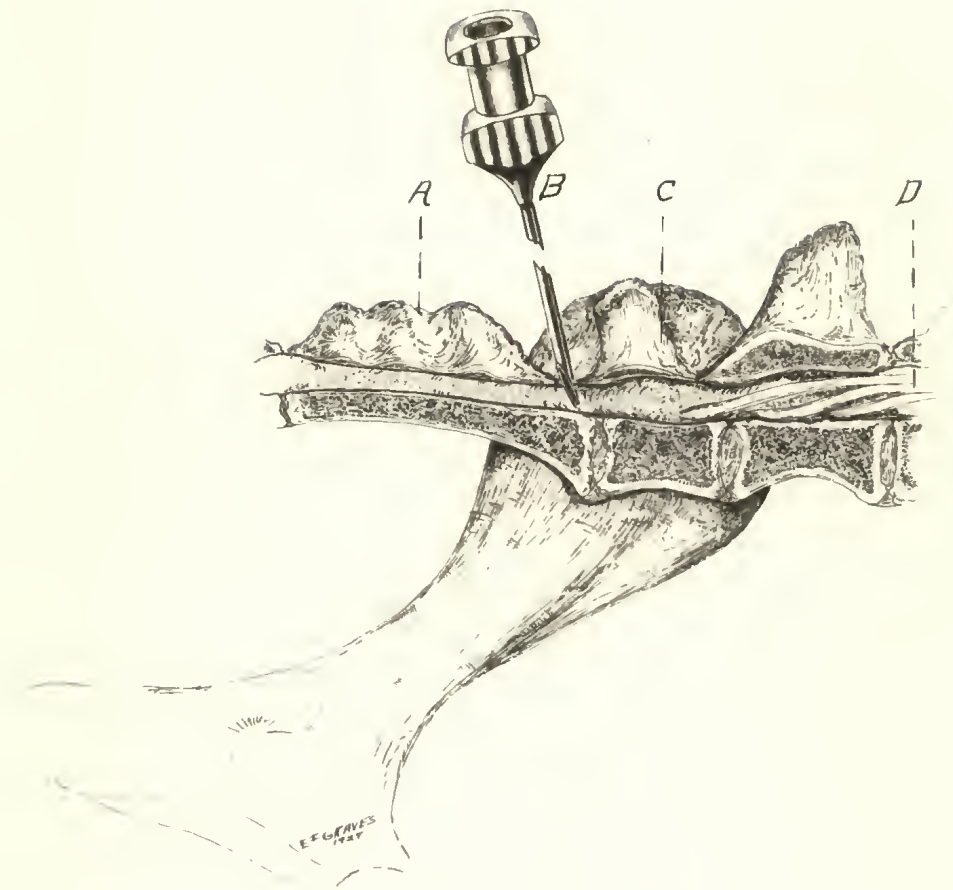

Figure 8. Anatomical structures involved in the dog. (A) Sacrum, (B) needle, (C) last lumbar vertebra, (D) termination of spinal cord.

The solution should be injected slowly as the patient may show some undesirable reaction if it is injected too rapidly. One cubic centimeter of a 2 per cent solution of procaine for each five pounds of body weight is usually sufficient. The injection of the anesthetic fluid into the sacral canal requires no pressure and imparts the impression of being made into a free space or into another fluid. After the anesthetic is injected the dog should be held in dorsal recumbency and the posterior parts elevated for a few minutes so that the anesthetic fluid will gravitate forward and anesthetize the sensory nerves supplying the abdominal cavity. When anesthesia is complete there will be paralysis of the posterior extremities and relaxation of the abdominal muscles. Any operation may be performed in the abdominal cavity or the parts posterior with perfect anesthesia.

Caudectomy

Operations only on the Tail

Anesthesia of the tail may be produced in mature dogs by injecting one cubic centimeter of a 1 per cent solution

of procaine epidurally. After injecting the solution the dog should be made to sit down so that the solution will remain in the posterior part of the canal. Anesthesia is usually complete in three minutes so that any operation may be painlessly performed on the tail. For puppies one-half cubic centimeter of a 1 per cent solution is usually sufficient.

Case Report No. 1. Male dog, weight about 15 pounds. Portion of tail to be removed. Animal received one cubic centimeter of a 1 per cent solution of procaine in the epidural space. After a lapse of three minutes a portion of the tail was removed painlessly.

Case Report No. 2. Female dog, weight about 50 pounds. Animal to be spayed. Dog received 10 cubic centimeters of a 2 per cent solution of procaine in the epidural space. Anesthesia was complete in 10 minutes and the operation performed painlessly.

Case Report No. 3. Male dog, weight about 10 pounds. Cecum to be removed, and castrated. Animal received three cubic centimeters of a 2 per cent solution of procaine in the epidural space. Anesthesia was complete in 10 minutes and operations performed painlessly.

Case Report No. 4. Female dog, weight about 60 pounds. Had been having difficulty in whelping. Animal received 13 cubic centimeters of a 2 per cent solution of procaine in the epidural space. Anesthesia was complete in 10 minutes and the caesarean section performed painlessly.

REGIONAL ANESTHESIA IN THE CAT

Regional anesthesia in the cat is accomplished in the same manner as in the dog.

The landmarks for finding the point of injection are the same as in the dog. The needle will have to be inserted from one-half to three-quarters of an inch, depending upon the size of the cat. Three cubic centimeters of a 2 per cent solution of procaine is used for mature cats. For younger animals the amount of solution used will vary according to the size of the animal. After the injection has been made the patient is placed in dorsal recumbency and the posterior parts elevated for a few minutes. Anesthesia is usually complete in 10 minutes so that any operation may be painlessly performed in the abdominal cavity.

Case Report No. 1. Female cat, age two years. To be spayed. Animal received three cubic centimeters of a 2 per cent solution of procaine into the epidural space. Anesthesia was complete in 10 minutes and the operation performed painlessly.

Case Report No. 2. Female cat, age six months. To be spayed. Animal received two cubic centimeters of a 2 per cent solution of procaine into the epidural space. Anesthesia complete in 10 minutes and operation performed painlessly.

DENTAL ANESTHESIA IN THE DOG

Anesthesia of the teeth of dogs is accomplished by blocking the infraorbital and mandibular alveolar nerves. The infraorbital nerve is the largest branch of the maxillary nerve. It passes through the infraorbital canal and contributes filaments to the teeth called dental branches. On emergence from the canal it divides into several branches which supply the upper lip and the nose. The mandibular nerve gives off dental branches to the teeth of the lower jaw and is arranged similar to the corresponding nerves of the upper jaw. It also gives off branches to the lower lip.

To block the infraorbital nerve select a point about one and one-half inches below the lateral canthus of the eye in the space between the posterior border of the malar bone and the anterior border of the coronoid process of the mandible.

The field should be shaved and disinfected and an insensitive wheal made in the skin at the point of insertion of the needle. The needle is inserted vertically through the skin and pushed through the soft tissues in the space between the anterior border of the coronoid process of the mandible and the malar bone, until its point has passed the edge of the latter. It is then directed forward along an imaginary line that would reach the gingival margin of the upper incisor teeth until the point of the needle reaches the maxillary foramen where the nerve is lodged and the injection is to be made. This is at a depth of approximately one to one and one-half inches from the surface in an average sized dog. Inject two cubic centimeters of a 2 per cent solution of procaine. Incline the dog's head downward so that the solution will remain around the nerve. Anesthesia should be complete in 10 minutes and last for approximately 20 minutes. (Fig. 9)

Figure 9. Needle in proper position for blocking the infraorbital nerve.

The blocking of the mandibular alveolar nerve is relatively simple. Pass the finger along the lower border of the mandible from front to back to where there is a depression. The point to insert the needle is at the lowest point of the depression. Insert the needle directly upward close to the medial surface of the mandible for a distance of one-half to three quarters of an inch and inject two cubic centimeters of a 2 per cent solution of procaine. Anesthesia will take place as described for the preceding nerve. (Fig. 10)

Figure 10. Needle in proper position for blocking the mandibular alevolar nerve.

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